

Is Your Validation Team Ready for EVs? 4 Things You Need to Know

The tools and procedures you use to test and validate gasoline and diesel vehicles might not be adequate for electric vehicles (EVs).

Electric vehicle sales are increasing 37% per year.

Batteries account for 40% of the cost of an electric vehicle.

By 2025, the US will have 18 million EVs on the road.

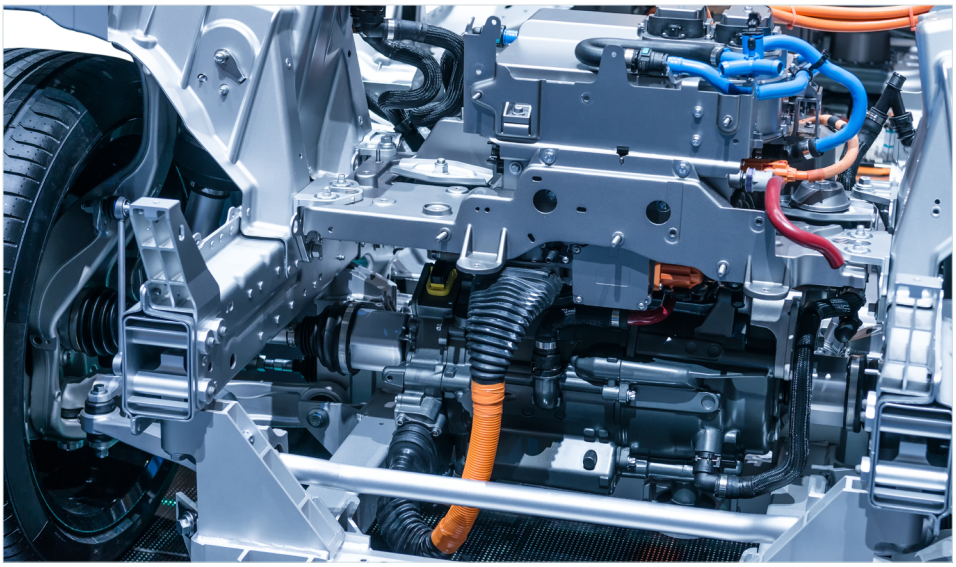
The automotive industry is going electric. Currently, electric vehicle (EV) sales are increasing by an average of 37% per year, and some industry watchers expect that rate to increase over the next few years. New EV startups seem to be cropping up almost every day, and several of the large, well-established manufacturers have announced that they expect to be selling only EVs within ten to fifteen years.

Those goals are ambitious because manufacturers face a number of challenges in bringing more EVs to market. Not only do they need to develop new technologies that will make electric vehicles desirable and affordable, they also need to re-architect their processes and procedures for testing and validating those vehicles to make sure that they are safe and provide the level of quality that customers expect.

Validating an EV isn't necessarily harder than validating an internal combustion engine (ICE) vehicle, but it is different. Obviously, EVs don't have all the same engine components as ICE vehicles, and they also have some different systems that your team might not have validated before. The regulatory requirements also require some slight modifications to existing procedures. In addition, EV drivers have different concerns and even drive in different ways than other drivers.

In short, if you are using the same testing processes, tools, and methodologies for EV that you use for traditional gasoline and diesel vehicles, you might be missing critical data and insights.

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Here are four things you'll need to take into account when validating electric vehicles:

1. You need to consider different factors when calculating energy efficiency.

Government regulators have long required manufacturers to calculate fuel economy, and customers use these ratings to help select vehicles for purchase. However, the procedure for calculating fuel economy is different on EVs than for ICE vehicles, and it requires you to collect different data signals from the vehicle.

Even the units are different since miles per gallon (mpg) obviously doesn't apply to EVs. Unfortunately, the industry and regulators haven't even yet settled on a standard unit for EV fuel efficiency, so you might need to report efficiency in miles per gallon equivalent (MPGe), liter equivalent per 100 kilometers (Le/100km), miles per kilowatt hour (mi/kWh), kilowatt hours per 100 kilometers (kWh/100 km) and/or watt-hours per mile (Wh/mi).

In addition, regenerative braking (the system that allows the vehicle to recover some kinetic energy during braking to charge the vehicle) changes the energy efficiency calculation. And you'll also want to calculate how well your regen brakes are performing and troubleshoot potential issues.

As with charging, running analytics on energy efficiency numbers from multiple testing fleets can give you much more accurate data about real-world use of your EVs. You can use that information to improve product quality over time and reduce warranty costs.

2. It's all about the battery (and the battery monitoring system).

The high-voltage lithium-ion batteries that power EVs are large, powerful, and extremely complex. And if something goes badly wrong with them, the result can be disastrous — fire, toxic smoke, or even an explosion. You need to be sure that you have adequately tested and validated your battery and battery monitoring system for safety reasons above all else.

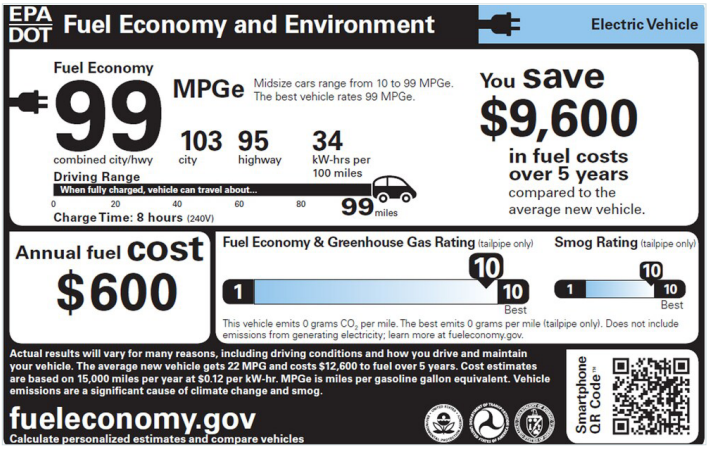
In addition, a lot of different factors can impact the life of a battery and its overall performance. For example, external temperature plays a big role in how long it takes to charge the battery, how long the charge lasts, and ultimately how long the battery itself lasts. That's why battery monitoring systems keep track of the battery temperature and instigate appropriate actions to make sure the temperature remains within an acceptable range. You'll need to make sure you validate the performance of both the battery and the battery monitoring system in all weather conditions.

Driver behavior can also impact battery health. Overcharging, allowing the charge to run all the way out, or frequently recharging the battery can also decrease its useful life.

Collecting and analyzing data related to batteries and monitoring systems can help you design more robust systems. That in turn makes it less likely that your customers will experience a catastrophic failure and less likely that you'll need to replace the battery under warranty.

3. Range anxiety is real — and extremely important.

You probably know (or perhaps are) an ICE vehicle driver who has no qualms about running their vehicle down to the last drops of gasoline in the tank before they fill up. Because there are gas stations on almost every corner in most parts of the world, ICE drivers know they can wait until the last possible second to stop for gas.



But the situation is much different for EVs. Charging stations are not nearly as widespread. As a result, EV drivers are far more concerned about where the next station is and how far they can get on a charge. And many are a lot more nervous when they run low on charge.

You can get a real-world view of how range anxiety affects driver behavior by running analytics on range data collected by your test fleets. These analytics can help you see how far drivers actually go on a single charge, which can better inform your marketing decisions and software strategies.

You can also use the data you collect from test fleets to help validate the model that you use to calculate the range numbers your vehicles display to drivers. As you know, a lot of different factors, like terrain, traffic, current temperature and weather conditions, age of the battery, and driver behavior, all affect range. The more accurate your range estimates are, the more you will alleviate your customers' range anxiety. Analytics can help you improve the customer experience, which in turn impacts your company's bottom line.

4. Some of the most important data is generated while the car isn't moving.

Most vehicle data-logging devices start collecting data once the driver turns on the engine. That works great for ICE vehicles, but it doesn't really work well for EVs. That's because the engine is off when the EV is charging. If your logger isn't on and capturing data during charging cycles, you're missing some of the most critical data. In addition, you need a data logger that can support all three different types of charging stations. (See table.)

During charging you'll also want to capture data about whether drivers are charging the vehicles all the way to 100% or stopping at 80% or 90% (or somewhere else.) You can then use that data to evaluate battery performance and range at various levels of charge.

Why is that important? Two reasons. First, the lithium-ion batteries in EVs degrade over time (just like the batteries in cell phones). And if you charge the battery to 100% capacity every time, it degrades faster. You might want to recommend that drivers only ever charge to 80% or 90% or even calibrate your battery management system so that it prevents 100% charge.

Charging Station Levels

	Level 1	Level 2	Level 3 (DCFC)
Location	Home	Home, work, public	Public
Approx. time to charge	20–40 hours	5–11 hours	30+ minutes
Outlet voltage	120V	208V or 240V	208V or 480V
Outlet current	12-16 amps	12-80 amps (typically 32 amps)	<125 amps (typically 60 amps)
Cost	$	$$	$$$

Aptiv Connect Qualifier and Electric Vehicles

Aptiv Connect Qualifier is a complete, end-to-end vehicle data solution for ICE, HEV, and BEV validation. It includes

- Edge hardware that collects more signals in finer detail than other solutions, including data on charge cycles
- Connect Edge software that processes data in the vehicle to keep data transmission costs low and transmit only the valuable insights to the cloud
- Developer software that allows Aptiv's customer success engineers (CSEs) to remotely configure your hardware to collect exactly the signals you need and change that data collection as necessary for an entire fleet or a single vehicle
- Qualifier web application that allows you to view your vehicle data, perform analytics on data collected across your fleet, incorporate external weather data, run reports, investigate root causes for issues, and set up alerts
- Professional services provided by our team of customer success engineers and data scientists, including EV experts, that help ensure you achieve maximum value from your investment

Optional add-ons, such as four-camera video, the Qualifier ADAS Solution, Environmental Insights (road and weather data integration), Video Insights (video recognition), and AC-Dash (Android tablet app for in-vehicle use) extend Qualifier's capabilities.

For more information, visit aptiv.com/connected-services or email sales@aptivcs.com.

Second, drivers don't always have enough time (or patience) for a full charge. Battery charging doesn't happen at a steady rate; the closer the battery gets to 100%, the more slowly it will charge. If a driver is using a fast charging station because they are in a hurry, they probably won't want to wait around for the last 10% or 20%.

That brings up an important reason for collecting this charging data. Manufacturers need to be able to run analytics on driver behavior so that they can see how close to 0% EV drivers are willing to go before they recharge and how long charging cycles actually take. This not only lets them provide more accurate estimates to drivers, it also allows them to design future products that more closely align with customer preferences.

And of course, you also need to validate the performance of the battery and electrical system in the vehicle. You need to determine charging efficiency and calculate how much energy is lost to heat in general or used for battery conditioning. This information can help you troubleshoot any problems, leading to increases in customer satisfaction and decreases in warranty costs.

Preparing today for the next generation of electric vehicles

The data you collect from individual electric vehicles is very useful for validating the performance of the components and systems in the vehicle. But it can be even more valuable to aggregate and analyze that data.

We're still in the early stages of the transition to EV. Future vehicles will likely have much different — and better — capabilities than those currently available. The validation data that you collect today can help you answer extremely important questions.

For example, you can learn how often people charge their vehicles, which types of stations they use, how long charging cycles last, how far people drive per trip, and much more.

Analyzing that data can provide valuable insights into what features will be most valuable in tomorrow's EVs. And in the end, that can help you improve customer satisfaction, and more importantly, increase sales.



Battery Charge Efficiency Analytics Dashboard



About Aptiv

Aptiv PLC (NYSE: APTV) is a global industrial technology leader delivering advanced solutions people trust when it matters most across automotive, commercial vehicle, aerospace and defense, telecom and datacom, and other diversified industrial end markets.

Our differentiated portfolio enables devices and systems to sense, think, act, and continuously optimize performance. Building on decades of innovation, Aptiv brings global scale and a resilient, localized value chain to customers across the globe. Learn more at Aptiv.com